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## The Pteridophyta of the arctic regions

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The number of species of Pteridophyta growing in arctic regions is larger than one should imagine judging from the unfavorable climatic conditions of these regions. Still it must be remembered that the arctic regions north of the forest region of the Old and New World measure millions of square kilometers of very different nature, and one need not wonder that within such a vast area certain places are found where ferns can grow. Such places are, however, few and confined to certain smaller areas. The immense tundras of North America and North Asia are practically without true ferns, while some species of *Equisetum* and *Lycopodium* there find rather favorable habitats, the former in the numerous marshes and boggy places, the latter in the drier heaths of the slopes of the more undulated land among ericaceous shrubs (*Callinea*, etc.). Quite different as to climatic and partly as to edaphic conditions are the coast lands adjoining the straits between the Arctic Ocean and the Atlantic and Pacific oceans, Bering Strait, Baffin Bay with Davis Strait, and the broad gap between Greenland and Norway. There the warmer water coming from the south has a favorable effect on the temperature and the humidity

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of the air, especially during the summer, and here we find ferns.

The northeastern corner of Asia (Chukches Land) is inhabited by three or four species of ferns, and from the opposite coast of Alaska Miss Alice Eastwood has enumerated not a few species collected near Nome City, among which are *Cystopteris montana* and *Gymnopteris triangularis*, which two species are unknown elsewhere in arctic regions. The former is a rather common species north of the polar circle in the Scandinavian peninsula, but it does not occur north of the forests. The occurrence of the second in arctic America is very surprising. It is a species of tropical relationship, which extends northward along the warm Pacific coast to British Columbia, and it is very strange that it should reach as far north as to Nome City. I do not remember whether the record is confirmed or not.

The regions around Baffin Bay (Baffin Land, Ellesmere Land, Grinnell Land on the west, and West Greenland on the east) are the headquarters of arctic ferns, and especially West Greenland possesses about the whole number of species. The outer conditions are here very favorable; a warm current, a branch of the Gulf Stream, runs along the west coast of Greenland, while on the other hand, the passages between Baffin Bay and the Arctic Basin are very narrow, and only small quantities of sea ice find the way through them to the bay. The summer is rather warm and the water open during the summer months as far north as to 83° N. lat. Because of these circumstances, the immense mass of land ice, which covers almost the whole archipelago, does not reach to the very shore, but leaves a rather broad coast land free from ice. This coast land is a rocky, often high country with deep fjords, which are often surrounded by land of comparatively low latitude, where sheltered, rather warm places are to be found. In these

places the vegetation may be remarkably rich, both in species and individuals, and even trees (birches) attain here a really considerable size. Ferns are here represented by several species which do not occur elsewhere in the arctic regions; for instance, *Dryopteris filix mas*, *D. Linnæana*, *D. phegopteris*, *D. dilatata*, *Polystichum lonchitis*, *Athyrium alpestre*, *Asplenium viride*, and species of *Botrychia*. In this region the fern vegetation reaches its farthest north, in Grinnell Land, 81° 50' N. lat., where *Cystopteris fragilis*, *Equisetum arvense*, *E. variegatum*, and *Lycopodium selago* were found. In the Hayes Sound region, at about 79° N. lat., the ferns are rather numerous, and the botanist of the Sverdrup expedition, 1898-1902, Dr. Simmons, named a valley in the outer part of Hayes Land (Buchanan Strait) *Lastræa Valley*, where he found *Dryopteris* (*Lastræa*) *fragrans* in plenty.

The coast of East Greenland is colder than the west coast, because the huge masses of sea ice find their way out from the Arctic Basin to the Atlantic Ocean between Iceland and Greenland. The coast opposite Iceland is ice-covered to the very shore and here vegetation is practically wanting, but south and north of here an ice-free foreland is to be found, which, especially northwards, (from about 70° to 76° N. lat.) is of considerable breadth. Five species (*Cystopteris fragilis*, *Woodsia glabella*, *Equisetum arvense*, *E. variegatum*, and *Lycopodium selago*) extend here to about 78° N. lat.

The islands west of Greenland, Yan Mayen, Spitzbergen, Franz Josef Land (Iceland is generally not included in the arctic regions) are very poor in ferns. In Yan Mayen are found *Cystopteris* and *Equisetum arvense*, in Spitzbergen *Cystopteris fragilis*, *Woodsia glabella*, *Equisetum arvense*, *E. variegatum*, *E. scirpoides*, and *Lycopodium selago*. From Franz Josef Land no species of ferns have hitherto been recorded.

As might be expected, no arctic species is endemic;

all the species found are common in northern Europe and North America. Further, it is difficult to point out differences between the arctic forms of a species and those of the temperate regions. Some of them (especially the *Equiseta* and *Lycopodia*) are represented by low, appressed forms, which, however, may be found also in mountains of the temperate zone. No species may be said to be especially accommodated to arctic climate; *Dryopteris fragrans* and species of *Woodsia* might seem to be so by their dense covering of scales, but it is better to say that they are accommodated to the alpine climate of the higher mountains of the temperate regions and, therefore, possess the power of enduring the extreme climate of the farthest north.

A study of the arctic ferns will throw light upon several difficult problems with regard to the relationship between the American and the European flora. I shall, however, not discuss these questions here but perhaps make them the subject of a later paper.

In the following list all species of Pteridophyta known as arctic are enumerated; the figure added to each species means the degree of latitude of the northernmost locality in which the species was found.

1. *Woodsia alpina* (Bolton) Gray. Hayes Sound, 78° 53'; East and West Greenland, about 74°; Baffin Land.

2. *W. ilvensis* (L.) R. Br. Baffin Land; W. Greenland, 72° 48'; E. Greenland, 70°; Chukches Land.

3. *W. glabella* R. Br. Baffin Land; W. Greenland, 74° 18'; Hayes Sound, about 79°; E. Greenland, about 77°.

4. *Cystopteris fragilis* (L.) Bernh. Perhaps the most common arctic fern, found throughout, where ferns grow, extending to 81° 43' (Grinnell Land); in E. Greenland to 78° 30'.

5. *C. montana* (L.) Bernh. Alaska: Nome City.

6. *Polystichum lonchitis* (L.) Roth. W. Greenland, 69° 14'; E. Greenland, 65°.

7. *Dryopteris filix mas* (L.) Schott. S. Greenland, 60-62°.

8. *D. fragrans* (L.) Schott. All around the arctic coasts and islands, extending to 79° (Hayes Sound). *D. aquilonaris* Maxon, from Nome City, is a forma *erosa* of this species.

9. *D. spinulosa dilatata* (Hoffm.) Und. Kotzebue Sound; W. Greenland, 69° 14'.

10. *D. phegopteris* (L.) C. Chr. W. Greenland, 65°; Alaska.

11. *D. Linnæana* C. Chr. W. Greenland, 69° 15'.

12. *Athyrium alpestre* (Hoppe) Ryl. S. Greenland, 60° 61'.

13. *Asplenium viride* Huds. W. Greenland, 62°; E. Greenland, 65° 35'.

14. *Botrychium lunaria* (L.) Sw. W. and E. Greenland, 70°.

15. *B. boreale* Milde. S. Greenland, 61°.

16. *B. lanceolatum* Angstr. W. Greenland, 63°.

17. *B. simplex* Hitch. W. Greenland, 60° 5'; a single plant found.

18. *Equisetum hiemale* L. W. Greenland, 60° 53'.

19. *E. variegatum* Schleich. Scattered over the archipelago north of America, extending to 81° 50' (Grinnell Land), eastwards to Spitzbergen; Chukches Land.

20. *E. scirpoides* Michx. Kotzebue Sound; W. Greenland, 70°; Spitzbergen; the arctic regions of the Old World, reaching its farthest north (74°) in Novaya Zemlya.

21. *E. silvaticum* L. Kotzebue Sound; W. Greenland, 70°.

22. *E. arvense* L. Widely distributed, extending to 81° 43' (Grinnell Land). The species is a variable one

and several dwarf forms have been described as varieties (var. *arctica* Rupr., var. *boreale* Milde, etc.).

23. *E. palustre* L. "Shores of the Arctic Sea" (Hooker).

24. *Lycopodium selago* L. Along the arctic coasts all around and found in most islands, extending to 81° 43' at Grinnell Land and to 77° in E. Greenland.

25. *L. annotinum* L. Kotzebue Sound; Baffin Land; W. and E. Greenland to about 72°. The typical form is rare, the species being represented by a shorter, more rigid form, var. *pungens* Desv.

26. *L. clavatum* L. S. Greenland, 61°.

27. *L. complanatum chamæcyparissus* (A. Br.). W. Greenland, 69° 14'.

28. *L. alpinum* L. Baffin Land; W. and E. Greenland, 70°; Chukches Land.

29. *Selaginella selaginoides* (L.) Lk. W. Greenland, 64° 8'.

30. *S. rupestris* (L.) Spring. Mouth of Kolyma River, Northeast Siberia.

31. *Isoetes lacustris* L. W. Greenland, 60°.

32. *I. echinospora* Dur. W. Greenland, 68° 21'.

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